In re Appln. of Nanping Wu
Application No. 09/891,576

LISTING OF CLAIMS

1. (Currently Amended) An evaporator adapted for use in a vapor-compression refrigeration cycle in a plate freezer comprising:

a longitudinally extending freezer plate body having a first generally planar heat transfer surface, a second generally planar heat transfer surface spaced apart from the first heat transfer surface, to define a plate body solid volume; and

at least one longitudinally extending duct passing through the plate body solid volume to channel a refrigerant maintained at a relatively high pressure, the duct having an elliptical cross-section which maintains a stress level in the plate body, caused by the relatively high pressure refrigerant flowing through the duct at a flow rate and pressure sufficient to reduce the temperature at the first and second heat transfer surfaces to a freezer operating temperature, at a level substantially below the yield strength of the material from which the plate body is constructed.

2. (Currently Amended) The invention as in claim 1 wherein the spacing between the first and second heat transfer surfaces and the dimensions of the elliptical duct are such that the von Mises stress is less than the yield strength of the material from which the [evaporator] plate body is constructed when the fluid has a pressure of approximately 1400 psig.

3. (Currently Amended) The invention as in claim 1 wherein at least one heat transfer surface contacts items to be frozen [in a plate freezer].

4. (Currently Amended) The invention as in claim 1 wherein both heat transfer surfaces contact items to be frozen [in a plate freezer].

5. (Original) The invention as in claim 1 wherein the duct extends throughout substantially the entire plate body in a serpentine manner.

6. (Original) The invention as in claim 5 wherein the plate body has a length and a width with the length substantially greater than the width and the serpentine duct extends substantially throughout the entire plate body along the length of the plate body.

7. (Original) The invention as in claim 5 wherein the serpentine duct makes seven passes through the plate body.

8. (Original) The invention as in claim 1 wherein the ratio between the total ellipse area to the total cross-sectional freezer-plate area is between about .57 and about .67.

9. (Original) The invention as in claim 1 wherein each elliptical duct has a first diameter and a second diameter with the first diameter being greater than or equal to the second diameter and the ratio between the first diameter and second diameter is between about 2.0 and about 2.35.

10. (Original) The invention as in claim 1 wherein the refrigerant passing through the evaporator is a CFC refrigerant.

11. (Original) The invention as in claim 1 wherein the refrigerant passing through the evaporator is a non-CFC refrigerant.

12. (Original) The invention as in claim 1 wherein the refrigerant passing through the evaporator is carbon dioxide.

13. (Original) The invention as in claim 1 wherein the refrigerant passing through the evaporator is ammonia.

14. (Original) The invention as in claim 1 wherein the refrigerant passing through the evaporator is at a pressure between about 100 psig and about 200 psig.

15. (Original) The invention as in claim 14 wherein the refrigerant passing through the evaporator is carbon dioxide.

16. (Currently Amended) A plate freezer comprising:

a compartment wherein the temperature of the compartment is less than or equal to approximately 0° Celsius; and

a plurality of spaced-apart shelves located in the compartment with each of the shelves adapted to receive items to be frozen between the adjacent shelves, each of the shelves include a plurality of generally rectangular plates having a length and a width with the length substantially greater than the width, the plates are disposed in an abutting relationship along their respective lengths, each plate has a first generally planar heat transfer surface, a second generally planar heat transfer surface spaced apart from the first heat transfer surface, to define a plate body solid volume; and

at least one longitudinally extending duct passing through the plate body solid volume to channel a refrigerant maintained at a relatively high pressure, the duct having an elliptical cross-section which maintains a stress level in the plate body, caused by the relatively high pressure refrigerant flowing through the duct at a flow rate and pressure sufficient to reduce the temperature at the first and second generally planar heat transfer surfaces to a freezer operating temperature, at a level substantially below the yield strength of the material from which the plate body is constructed.

17. (Original) The invention as in claim 16 wherein the spacing between the first and second surfaces and the dimensions of the elliptical duct are such that the von Mises stress is less than the yield strength of the material from which the plate is constructed when the refrigerant has a pressure of approximately 1400 psig.

18. (Original) The invention as in claim 16 wherein the duct extends throughout substantially the entire plate body in a serpentine manner.

19. (Original) The invention as in claim 18 wherein the serpentine duct extends substantially throughout the entire plate body along the length of the plate body.

20. (Original) The invention as in claim 18 wherein the serpentine duct makes seven passes through the plate body.

21. (Original) The invention as in claim 16 wherein the ratio between the total ellipse area to the total cross-sectional freezer-plate area is between about .57 and about .67.

22. (Original) The invention as in claim 16 wherein each elliptical duct has a first diameter and a second diameter with the first diameter being greater than or equal to the second diameter and the ratio between the first diameter and second diameter is between about 2.0 and about 2.35.

23. (Original) The invention as in claim 16 wherein the refrigerant passing through the plate is a CFC refrigerant.

24. (Original) The invention as in claim 16 wherein the refrigerant passing through the plate is a non-CFC refrigerant.

25. (Original) The invention as in claim 16 wherein the refrigerant passing through the plate is carbon dioxide.

26. (Original) The invention as in claim 16 wherein the refrigerant passing through the plate is ammonia.

27. (Original) The invention as in claim 16 wherein the refrigerant passing through the plate is at a pressure between about 100 psig and about 200 psig.

28. (Original) The invention as in claim 27 wherein the refrigerant passing through the evaporator is carbon dioxide.

29. (Currently Amended) An evaporator for a plate freezer comprising:

a plurality of spaced-apart shelves located in the compartment with each of the shelves adapted to receive items to be frozen between the adjacent shelves, each of the shelves include a plurality of generally rectangular plates having a length and a width with the length substantially greater than the width, the plates are disposed in an abutting relationship along their respective lengths, each plate has a first generally planar heat transfer surface, a second generally planar heat transfer surface spaced apart from the first heat transfer surface, to define a plate body solid volume;

at least one longitudinally extending duct passing through the plate body solid volume to channel a refrigerant maintained at a relatively high pressure, the duct having an elliptical cross-section which maintains a stress level in the plate body, caused by the relatively high pressure refrigerant flowing through the duct at a flow rate and pressure sufficient to reduce the temperature at the first and second heat transfer surfaces to a freezer operating temperature, at a level substantially below the yield strength of the material from which the plate body is constructed; and

wherein the ratio between the total ellipse area in a plate to the total cross-sectional freezer plate area of that plate is between about .57 and about .67.

30. (Original) The invention as in claim 29 wherein the spacing between the first and second heat transfer surfaces and the dimensions of the elliptical duct are such that the von Mises stress is less than the yield strength of the material from which the evaporator is constructed when the fluid has a pressure of approximately 1400 psig.

31. (Original) The invention as in claim 29 wherein the duct extends throughout substantially the entire plate body in a serpentine manner.

32. (Original) The invention as in claim 31 wherein the plate body has a length and a width with the length substantially greater than the width and the serpentine duct extends substantially throughout the entire plate body along the length of the plate body.

33. (Original) The invention as in claim 31 wherein the serpentine duct makes seven passes through the plate body.

34. (Original) The invention as in claim 29 wherein each elliptical duct has a first diameter and a second diameter with the first diameter being greater than or equal to the second diameter and the ratio between the first diameter and second diameter is between about 2.0 and about 2.35.

35. (Original) The invention as in claim 29 wherein the refrigerant passing through the evaporator is a CFC refrigerant.

36. (Original) The invention as in claim 29 wherein the refrigerant passing through the evaporator is a non-CFC refrigerant.

37. (Original) The invention as in claim 29 wherein the refrigerant passing through the evaporator is carbon dioxide.

38. (Original) The invention as in claim 29 wherein the refrigerant passing through the evaporator is ammonia.

39. (Original) The invention as in claim 29 wherein the refrigerant passing through the evaporator is at a pressure between about 100 psig and about 200 psig.

40. (Original) The invention as in claim 39 wherein the refrigerant passing through the evaporator is carbon dioxide.